

AD-D016 160



Serial No. 936,983

Filing Date 25 August 1992

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Distribution Unlimited

20P6 94-10366

94 4 5 043

1 POLYURETHANE SELF-PRIMING TOPCOATS

5 STATEMENT OF GOVERNMENT INTEREST

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

10 CONTINUATION APPLICATIONS

This application is a Continuation-In-Part of copending application Serial Number 07/812,174 filed December 20, 1991.

BACKGROUND OF THE INVENTION

15 This invention relates to novel coating compositions and more specifically to corrosion-resisting coatings which can be applied directly to various surfaces particularly metal either as a high or low gloss, self-priming topcoat.

20 Various surfaces and particularly metal surfaces require the protection of coatings especially when the surfaces are exposed to a corrosive environment. Metal surfaces of aircraft, for example, are exposed to seawater which require protection from corrosion. Specifically, aircraft, e.g., Navy

1 aircraft, are exposed to seawater spray in addition to various
acid-forming gases such as sulfur dioxide, carbon dioxide, etc.
Moreover, in addition to aircraft, various machinery and
equipment in the industrial environments, where fossil fuels
5 are used need protection against corrosion. It is important
therefore that the coating be resistant to corrosion, various
chemicals, the weather and at the same time be flexible and
have good adhesion to the substrates.

10 Presently, coating systems comprise one or more films,
i.e., an undercoat, a sealant and a topcoat. Aircraft, for
example, traditionally have been coated with high performance
two-component protective films consisting of an epoxy primer
and a polyurethane topcoat. The type of epoxy primers used on
the aircraft are designed to adhere to the metal surface and
15 help to improve the adhesion of the topcoat and together
prevent corrosion of the metal. However, these undercoats
require a topcoat, since the undercoats lack flexibility
especially at low temperatures (-60°F) resulting in extensive
cracking particularly in highly flexed areas of the aircraft.
20 Moreover, the undercoats usually lack weather resistance and
generally cannot be formulated in different colors required for
aircraft.

25 In comparison, the polyurethane coatings of this
invention, provides the necessary corrosion resistance, the
required degree of flexibility, the desired optical properties,

1 and a resistance to weather and various chemicals. To obtain
these characteristics, the multi-film coatings used heretofore
generally required a dry-film thickness ranging up to about
0.005 inches, e.g., up to about 10 mils or more which added
5 considerable weight to the aircraft. In addition, the multi
coats are time consuming to apply particularly since there is a
drying time between each application. Further, the removal of
a two-coat system can be difficult and time consuming and
generates high levels of volatile organic (VOC) emissions
10 during the operations.

In accordance with this invention the corrosion-resistant
coating comprise a polyurethane binder derived from the
reaction of at least one polyol, e.g., polyester polyol and an
isocyanate, e.g., hexamethylene diisocyanate (HDI) or
15 polyisocyanates in combination with a unique mixture of
corrosion-inhibiting pigments consisting essentially of (1) an
alkaline earth metal phosphate, e.g., zinc-barium phosphate,
(2) zinc salts of benzoic acid or substituted benzoic acid, and
(3) molybdate-modified zinc phosphates. All three of these
20 compounds are essential, in the stated relative proportions, to
provide a single high-gloss coating with the necessary
corrosion resistance and adhesion characteristics required of a
good top coat. In addition, titanium dioxide (TiO_2) including
spherical TiO_2 particles, e.g., vesiculated beads of TiO_2 are
25 included as a pigment together with these three alkaline earth

1 metal or zinc salts. The coating compositions of this
invention may be applied, as one coat, directly onto various
hard surfaces such as metal and/or organic matrix composites,
etc., and do not require an undercoat to provide a corrosion-
5 resistant finish with desired optical and adhesion properties.

SUMMARY OF THE INVENTION

A corrosion-resistant coating which can be applied
directly to a surface as a self-priming topcoat comprising from
about 20 to 60 parts by weight and preferably 30-50 parts of a
10 polymeric urethane resin binder and a combination of three
corrosion-resistant pigments consisting essentially of a
molybdate-modified zinc phosphate, zinc salts of benzoic acid,
and alkaline earth metal and/or zinc phosphates such as a
complex zinc-barium phosphate, together with dispersing agents,
15 TiO_2 pigments, and organic solvents

Accordingly, it is an object of this invention to provide
a corrosion-resistant coating which can be applied directly to
a surface e.g., metal, as a single coat.

It is another object of this invention to provide a
20 coating which is flexible, resistant to corrosion, chemicals,
and weathering, and has good adhesion characteristics.

It is still a further object of this invention to provide
a coating for use on military or civilian aircraft of reduced

1 thickness to lower the weight thereon while at the same time
providing the necessary corrosion resistance.

These and other objects of the invention are
accomplished, in accordance with this invention, by providing a
5 corrosion-resistant coating capable of being applied as a
single coating with appropriate optical properties.

THE PREFERRED EMBODIMENTS

This invention is directed to a corrosion-resistant
coating which functions as a primer and a topcoat. More
10 specifically, this invention relates to a corrosion-resistant
coating which comprises a major amount, e.g., 20 to 60 parts by
weight of a urethane resin, i.e., polyurethane resin binders,
and a minor amount of corrosion-inhibiting pigments, i.e.,
alkaline earth metal compounds and/or zinc salts. The unique
15 combination of pigments consist essentially of from about 5 to
35 parts and preferably 10 to 30 parts by weight of an alkaline
earth metal phosphate, e.g., zinc or zinc-barium phosphate, 0.5
to 5 parts and preferably 1 to 3 parts by weight of a zinc salt
of a benzoic acid or substituted benzoic acid, and about 5 to
20 30 parts and preferably 10 to 25 parts by weight of a
molybdate-modified zinc phosphate. In addition to the above
metal compounds, depending on the opacity, etc., required of
the coating, from 5.0 to 35 parts, and preferably from 5.0 to
15 parts by weight of titanium dioxide pigment, based on the

1 total weight of the coating, is added as an additional pigment.
Up to about 100% of the total amount of TiO_2 may be in the form
of vesiculated beads, e.g., from 0 to 50% of the TiO_2 in the
coating are beads. Generally, the coating is applied as a high
5 solids organic solution and therefore generally contains from 0
to 3.0 and preferably about 0.1 to 2.0 parts by weight of at
least one oil soluble dispersing or wetting agent such as Anti-
Terra-204 or BYK-320. Anti-Terra-204 is a carboxylic acid of
polyamine-amides and BYK-320 is a polyether modified
10 methylalkylpolysiloxane copolymers. Various other nonionic or
anionic dispersing agents known as oil soluble dispersants or
paint additives may be used in the coating. In addition, the
coating contains from about 0 to 50 parts, e.g. as needed or
from 10 to 25 parts by weight of the total coating of at least
15 one organic solvent, e.g., Mil-T-81772 or various mixtures of
paint solvents.

The organic binder of the coating comprises a
polyurethane, and more particularly an aliphatic polyurethane
derived from the reaction of a polyol and a multi-functional
20 aliphatic polyisocyanate. The polyol is preferably used as a
solution in an organic solvent e.g. toluene, xylene, n-butyl
acetate, propylene glycol monomethyl ether acetate, methyl
ethyl ketone, etc. The polyisocyanate is used as a 100% solid
but also can be diluted with any of the above organic solvents.
25 The hydroxyl number of the polyol, i.e., polyester polyols and

1 the isocyanate (NCO) content or the equivalent weights of the
polyisocyanate and polyol are determined in order to obtain the
desired polyurethane. The preferred polyols and
polyisocyanates are reacted in approximately stoichiometric
5 amounts so that the NCO to OH ratio ranges from about 0.85 to
1.4 equivalent of the NCO to 1.0 equivalent of the OH, or at
about a 1.0 to 1.0 ratio of the NCO to OH.

The combination of metal salts and/or pigments is unique
and consists essentially of specific amounts of an alkaline
10 earth metal phosphate, e.g., zinc phosphate or zinc-barium
phosphate etc., zinc salts of benzoic acid or a substituted
benzoic acid and a molybdate-modified zinc phosphate. These
three metal salts or pigments used alone and in combination
with TiO_2 provide outstanding corrosion protection and enables
15 the coating to be used as a self-priming high-gloss or low-
gloss topcoat.

The particular alkaline earth metal complexes or zinc
phosphates used in preparing the coating composition is
preferably a zinc-barium phosphate. The preferred zinc salt of
20 benzoic acid is specifically characterized as having at least
one hydroxyl group and nitro (NO_2) substituent and molecular
weights of about 100 - 500, e.g. 300, density of about 2-3
grams per milliliter and a specific surface area of $16M^2$ /gram.
The benzoic acid salts are commercial products obtained from
25 BASF and identified as Sicorin-RZ.

1 The preferred zinc salts of the benzoic acids have at
least one hydroxyl substituent and one (NO₂) group. The zinc
salt of the benzoic acids are further characterized as having
molecular weights of approximately 100 to 500. The preferred
5 zinc phosphates, are complex alkaline earth zinc phosphates,
e.g., zinc-barium phosphate. This zinc phosphate is available
as Phos-Plus (J0866) from Mineral Pigments Corporation. A
preferred molybdate-modified zinc phosphate, i.e, HEUCOPHOS-ZMP
from HEUCOTECH LTD. has the following analysis:

10 <u>Chemical Analysis</u>	<u>Percent</u>
Zinc content as Zn	55-57
Molybdate content as Mo O ₃	1.5
Phosphate content as PO ₄	38-41
Loss on ignition as 600°C	10-12
Water soluble Cl	<0.05
Water soluble SO ₄	<0.05
Water soluble Mo	0.1
15 pH	7

Other molybdate-modified zinc phosphates include the metal
complexes or mixtures of an alkaline earth metal from Group II
of the Periodic Table such as a zinc molybdate-zinc phosphate,
and more specifically a barium or calcium-zinc molybdate/zinc
20 phosphate, such as (CaMoO₄, CaCO₃, ZnO, Zn₃(PO₄)₂). These
complex or mixed metal phosphates are available commercially as
MOLY-WHITE from the Sherwin Williams Co. of Cleveland, Ohio.

25 In addition to utilizing the above combination of metal
pigments in the required ratios, titanium dioxide is added to
the coating to provide reinforcing strength and to add color,

1 hiding and opacity to the coating. Other additives that maybe
used include tinting or coloring agents which may be added to
the coating in small but effective amounts such as zinc oxide,
antimony oxides, barium sulfate, calcium carbonate and one or
5 more of the organic pigments such as the phthalocyanine colors
e.g. greens or blues, etc.

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1 Specifically, the corrosion resistant coatings of this invention can be prepared by milling the ingredients set forth in the following Examples.

	<u>EXAMPLE 1</u>	<u>EXAMPLE 2</u>
5	<u>Ingredients</u>	<u>Parts by Weight</u> <u>(Ranges)</u>
	Polyurethane Resin or Binder derived from polyester polyols and polyisocyanates	30-50
	Titanium dioxide	5-15
	Titanium dioxide (vesiculated beads)	0.1-5.0
10	Alkaline earth metal phosphates and complexes such as zinc and/or barium phosphates	10-30
	Zinc salts of substituted benzoic acids	1-3
	Molybdate-modified Zinc Phosphates (e.g., MOLY-WHITE-MZAP or HEUCOPHOS-ZMP)	10-25
15	Dispersing agents, e.g., Anti-Terra-204 (Oil Soluble Anionic or Nonionic dispersants)	0.1-2.0
	Organic solvents for coatings	0-50

20

EXAMPLE 3

	<u>Ingredients</u>	<u>Parts by Weight</u>
	Polyurethane Resin derived from polyester polyol in organic solvents (i.e., propylene glycol monomethylether acetate, N-butyl acetate) and polyisocyanate	39.2
5	Titanium Dioxide Pigment	10.2
	Titanium Dioxide Vesiculated Beads	0.6
	Zinc-Barium Phosphate	24.5
	Zinc Salt of a substituted Benzoic Acid (Sicorin RZ)	2.4
	Molybdate-Modified Zinc Phosphate (HEUCOPHOS-ZMP)	22.7
10	Dispersant (BYK-320)	0.3
	Organic Solvents	As Needed

EXAMPLE 4

	<u>Ingredients</u>	<u>Parts by Weight</u>
15	Polyurethane Resin derived from 79% solids solution polyester polyol in organic solvents (propylene glycol monomethyl ether acetate, n-butyl acetate) and 100% solids of a polyisocyanate	49.8
	Titanium Dioxide Pigment	32.1
	Titanium Dioxide Vesiculated Beads	0.0
	Zinc-Barium Phosphate	6.4
	Zinc Salt of a substituted Benzoic Acid (Sicorin RZ)	0.6
20	Molybdate-modified Zinc Phosphate (HEUCOPHOS-ZMP)	10.6
	Dispersant (Anti-Terra-204)	0.3
	Organic Solvents	As Needed

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EXAMPLE 5IngredientsParts by Weight

Polyurethane Resin derived from
79% solids solution of polyester polyol in
organic solvents (propylene glycol monomethyl
ether acetate, n-butyl acetate) and
100% solids of a polyisocyanate

32.7

5 Titanium Dioxide Pigment

14.7

Titanium Dioxide Vesiculated Beads

0.5

Zinc-Barium Phosphate

22.8

Zinc Salt of a substituted Benzoic Acid
(Sicorin RZ)

2.2

Molybdate-modified Zinc Phosphate
(Heucophos ZMP)

26.9

10 Dispersant

0.3

Organic Solvents

As Needed

EXAMPLE 6IngredientsParts by Weight

Polyurethane Resin derived from 79% solids solution of
polyester polyol in organic solvents (propylene
glycol monomethyl ether acetate, n-butyl acetate)
and 100% solids of a polyisocyanate

15

41.6

Titanium Dioxide

14.1

Titanium Dioxide Vesiculated Beads

1.4

Zinc-Barium Phosphate

23.5

Zinc Salt of a substituted Benzoic Acid
(Sicorin RZ)

2.3

20 Molybdate-modified Zinc Phosphate
(Heucophos ZMP)

16.8

Dispersant

0.3

Organic Solvents

As Needed

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EXAMPLES 7-10

		<u>% by Weight</u>			
	<u>Ingredient</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
	1. 79% solids solution polyester polyol in organic solvents (propylene glycol monomethyl ether acetate, n-butyl acetate)	27.4	34.2	23.0	28.9
5	2. Titanium Dioxide Pigment	10.6	32.6	15.3	14.4
	3. Titanium Dioxide Vesiculated Beads	0.6	0.0	0.5	1.5
	4. Zinc-Barium Phosphate	25.4	6.4	23.7	24.1
	5. Zinc Salt of a substituted Benzoic Acid (Sicorin RZ)	2.5	0.6	2.3	2.4
	6. Calcium-Zinc Molybdate/Zinc Phosphate (Moly-White MZAP)	20.1	9.5	24.0	14.7
10	7. Dispersant (Anti-Terra-204)	0.3	0.3	0.3	0.3
	8. (100% Solids) Polyisocyanate Resin	13.1	16.4	11.0	13.8

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EXAMPLES 11-14% by Weight

<u>Ingredient</u>		<u>E</u>	<u>F</u>	<u>G</u>	<u>H</u>
1.	79% solids solution polyester polyol in organic solvents (propylene glycol monomethyl ether acetate, n-butyl acetate)	25.7	33.2	21.3	27.5
5	2. Titanium Dioxide Pigment	9.9	31.6	14.1	13.8
	3. Titanium Dioxide Vesiculated Beads	0.6	0.0	0.5	1.4
	4. Zinc-Barium Phosphate	23.7	6.2	21.9	22.9
	5. Sicorin RZ	2.3	0.6	2.1	2.2
	6. Zinc Molybdate/Zinc Phosphate (Moly-White MZAP)	25.1	12.3	29.6	18.7
10	7. Dispersants (Anti-Terra-204/BYK-320)	0.3	0.3	0.3	0.3
	8. Polyisocyanate Resin (100% Solids)	12.3	15.8	10.2	13.1

In Examples 7-14, the polyester polyol blend was used as a solution, e.g., 79% solids in propylene glycol monomethyl ether acetate and butyl acetate. The polyisocyanate was 100% solids, e.g., substantially containing no solvents.

Preferably, the coatings are prepared by mixing all of the ingredients, except the polyisocyanate and then milling the mixture to a fineness of about 5 for camouflage and 7 for high gloss colors on the Hegman scale according to ASTM D1210. Subsequently, the polyisocyanate is added before the application of the coating to the substrate. The coating is

1 applied on the substrate at thickness ranging from about 0.001
to 0.003 inches e.g. from 0.5 to about 10 mils and preferably
1 to 3 mils. The coating may be applied by various methods
including spraying, rolling, or brushing onto the surface
5 depending on the viscosity. The viscosity of the coating for
the particular application may be achieved by adjusting the
content of the solvent within the ranges specified herein and
by the selection of the particular reactants used to form the
urethane resin. After the coating is applied to the surface,
10 the solvent is evaporated at room or elevated temperatures and
is allowed to cure to a film thickness having the desired
properties. The pigments can be introduced into the coating by
first forming a mill base with the polyester polyol. The mill
base can be formed, for example, by conventional sand-grinding
15 or ball-milling techniques, and then blended, by simple
stirring or agitation with the other ingredients of the
composition.

The combination of the molybdate-modified zinc
phosphates, the zinc salts of benzoic acid, e.g. zinc benzoate
20 and an alkaline earth metal phosphate, e.g., zinc or zinc-
barium phosphates, improved the corrosion resistance while
maintaining all the other desirable characteristics required of
the coating. In other words, the specific combination of a
zinc molybdate-zinc phosphate, a zinc salt of substituted
benzoic acid and zinc or zinc-barium phosphates, in the ratios

1 stated, improved the corrosion inhibition substantially when
compared to the use of either one of these metal salts alone in
the same coating.

5 More specifically in preparing the urethane resins, the
preferred polyester polyols of this invention have equivalent
weights ranging from about 260 to 970 with hydroxyl numbers
ranging from 40 to 252 and an acid number less than 10. The
polyols includes a variety of polyester polyhydroxyl compounds
known in the art including, for example, the condensation-
10 reaction products of pentaerythritol and/or glycols with
monocarboxylic acids or an aromatic or aliphatic dicarboxylic
acid. Any branched-chain glycol maybe used in the formation of
the polyester, although it is preferred that these glycols
contain no more than 8 carbon atoms. A useful polyol is formed
15 where the molar ratio of glycol to pentaerythritol is from 2:1
to about 6:1. The carboxylic acid component of the polyester
polyol prevents the molecular weight build-up of the polyol.
It has been found that any aromatic or aliphatic monocarboxylic
acid or mixtures of these having 18 or less carbon atoms can be
20 used. Normally, the acids are used in a molar ratio of acid to
polyalcohol of about 1:1 to 2.5:1.

25 Examples of aromatic monocarboxylic acids include benzoic
acid, butylbenzoic acid, triethyl benzoic acid, toluic acid,
phenylacetic acid, and the like. Examples of aliphatic acids
are acetic acid, propionic acid, butyric acid, valeric acid,

1 caproic acid, caprylic acid, pelargonic acid, capric acid,
lauric acid, myristic acid, palmitic acid, stearic acid, etc.

The dicarboxylic acids useful in the formation of the polyester polyols have the general formula:



where R is aliphatic or aromatic group. Preferred are succinic acid, glutaric acid, adipic acid and pimelic acid. Useful acids are those in which R has 2 to 8 carbon atoms with the preferred being maleic acid and itaconic acid. The aromatic
10 dibasic acids are phthalic, isophthalic, and terephthalic, although other aromatic dibasic acids can be used.

It is known that the lower alkyl mono- or diesters of these acids and the anhydrides thereof can be used in place of the free acids. Other known polyester polyols can be obtained
15 by the condensation reaction between a polybasic acid, such as adipic acid, phthalic anhydride, isophthalic acid, etc., and a diol or triol, such as ethylene glycol, diethylene glycol, propylene glycol, trimethylol propane, glycerine, etc.

The hydroxyl numbers of the preferred polyester polyols
20 should be at least 40 and preferably between 40 and 252. The polyesters, containing hydroxyl groups, are combined with the polyisocyanate. This combination can be carried out in several ways known to the art. For example, an organic solution of the

polyester containing, if desired, a catalyst-promoting urethane formation such as an organo-tin compound, is added to an chemical equivalent amount of the isocyanate. The combination is made at ambient temperature but the heat of reaction usually causes an increase in temperature. The mixture is agitated preferably at room temperature until the urethane reaction is substantially completed. The course of the reaction can be followed by noting the viscosity of the mixture. When the viscosity becomes substantially constant, it may be concluded that the reaction is substantially completed. The resultant reaction product may contain insignificant amounts of free isocyanate and/or hydroxyl groups.

Alternatively, the polyester solution can be reacted with a small excess, e.g. about 10% excess of the isocyanate. After the urethane reaction is substantially completed, the excess NCO groups can be reacted with "chain-extending" substances, e.g. water, alcohols, etc. This procedure results in polymers of substantially equivalent character but permits the reaction to proceed at a faster rate, due to the mass action of the excess NCO groups. The term "small excess" is intended to be included within the meaning of the term "stoichiometric amounts".

The polyisocyanates and particularly the aliphatic polyisocyanates based on HDI include various multi-functional aliphatic polyisocyanates having an isocyanate content (NCO)

1 ranging from about 10 to 30% by weight with an equivalent
weight (NCO) ranging up to about 300. Specific examples of the
organic polyisocyanates used in this invention make up about 5
to 30% and preferably 5 to 20% by weight of the film-forming
5 blend. These compounds include aliphatic, cycloaliphatic,
alkaryl, aralkyl, heterocyclic, and aryl di- or triisocyanates.
Specific compounds include, for example, polyisocyanates such
as:

diphenylmethane-4,4'-diisocyanate,

10 diphenylene-4,4'-diisocyanate

toluene-2,4-diisocyanate,

toluene-2,6-diisocyanate,

3,3'-dimethoxy-4,4'-diphenylene diisocyanate methylene-
bis-(4-cyclohexyl isocyanate)

15 tetramethylene diisocyanate,

hexamethylene diisocyanate,

decamethylene diisocyanate,

ethylene diisocyanate,

ethylidene diisocyanate,

20 propylene-1,2-diisocyanate,

cyclohexylene-1,2-diisocyanate,

m-phenylene diisocyanate,

p-phenylene diisocyanate, 1,5-naphthalene diisocyanate,

3,3'-dimethyl-4,4'-biphenylene diisocyanate,

25 3,3'-dimethoxy-4,4'-biphenylene diisocyanate,

3,3'-diphenyl-4,4'-biphenylene diisocyanate,

1 4,4'-biphenylene diisocyanate,
3,3'-dichloro-4,4'-biphenylene diisocyanate,
furfurylidene diisocyanate,
bis-(2-isocyanatoethyl) fumarate,
5 1,3,5-benzene triisocyanate,
para, para', para"-triphenylmethane triisocyanate,
3,3'-diisocyanatodipropyl ether,
xylylene diisocyanate,
B,B-diphenyl propane-4,4'-diisocyanate, and
10 isophorone diisocyanate. Preferred polyisocyanates include
hexamethylene diisocyanate and methylene-bis-(4-cyclohexyl
isocyanate) e.g. DESMODUR-N.

By selecting the proper polyols and by adjusting the NCO
to OH ratio, the physical properties and efficiency of the
15 film, such as the strength of film, flexibility, chemical
resistance, solvent resistance, etc., can be controlled over a
wide range. Compounds where the NCO to OH ratio ranges from
0.85 to 1.4 of NCO to 1.0 of OH groups e.g. 1.2:1 are useful
for the manufacture of coating in accordance with this
20 invention.

If the coating is derived from a two-package system, the
polyisocyanate is in one package and a solution of the polyol
is in a separate package. The two reactants, one containing
the pigments, are thoroughly mixed just before applying the
25 coating onto the surface. Separation of the two reactants is

1 usually necessary since the "pot life" of some of the
compositions is short. The polyisocyanate (NCO) reacts with
the hydroxyl groups of the polyol at temperature as low as
about 40°F (4°C). Regardless of the method by which the
5 coating composition is prepared, the coating should contain 20
to 60 parts by weight of the polyurethane resin and up to about
50 parts, e.g. 0-50 parts by weight of solvent. The solvent of
the composition can be a mixture of organic solvents wherein
the constituents of the urethane react.

10 Instead of the two-component or "two-package" system, a
"one package" coating can be used if the reactive groups of the
polyisocyanate are blocked with a blocking agent such a
methylethyl ketoxime. This eliminates the need for keeping the
polyol apart from the polyisocyanate until just before use.
15 When the coating, with the blocked polyisocyanate, is applied
and heated the blocking agent is released, permitting the
polyisocyanate to react with the polyester polyol.

The blocking agents are used for purposes of masking the
free isocyanate radical of the polyisocyanates. These agents
20 include phenol, m-nitrophenol, p-chlorophenol, ethyl malonate,
acetylacetone, ethyl acetoacetate, cresol, methanol, ethanol,
ethylene, chlorophydrin, etc. Although the temperatures at
which the above-mentioned blocking agents are dissociated
varies with the agents, it is generally accepted that heating
25 is required to deblock.

1 The coating composition also can contain ultraviolet
light stabilizers, antioxidants, catalysts, wetting or
dispersing agents, e.g., Anti-Terra-204 (carboxylic acid salts
of polyamine-amides), flow modifiers e.g. BYK-320 (polyether
5 modified methylalkyl polysiloxane copolymers), adhesion
promoters, etc. The ultraviolet light stabilizer can be
present in an amount of 1-10% by weight, based on the weight of
the urethane binder. The antioxidants can be present also in
amounts of 0.1-3% by weight of the urethane binder.
10 Ultraviolet light stabilizers include benzophenones, triazoles,
triazines, benzoates, substituted benzenes, organophosphorous
sulfides, etc.

 The coating composition of this invention may contain
about 0.01-2.0% by weight, based on the weight of the polymer
15 forming blend, of a curing catalyst. The catalysts are usually
organo metallics such as dibutyl tin dilaurate and zinc
octoate, dibutyl tin di-2-ethylhexoate, stannous octoate,
stannous oleate, zinc naphthenate, vanadium acetyl acetonate,
and zirconium acetyl acetonate. Also useful as catalysts are
20 tertiary amines, such as, for example, triethylene diamine,
triethylamine, pyridine, dimethylaniline, and methyl
morpholine. When a two-component system is used, the catalyst
can be added to either the polyisocyanate or the solution of
the polyester polyol.

1 The coating composition of this invention can be applied
to a variety of substrates by conventional application methods
such a spraying, dipping, brushing, or flow coating.
Substrates that can be coated with the composition are, for
5 example, metal, wood, glass, or plastics such as polypropylene,
polystyrene, and the like. The coating is particularly suited
for application over pretreated or unprimed metal. The coating
can be cured at ambient temperatures or heated at 40°-120°C.
for up to an hour or more. If the coating contains a blocked
10 polyisocyanate, temperatures ranging up to about 160°C may be
necessary.

 The solvent may include a mixture of organic solvents,
e.g., benzene, toluene, xylene, and naphtha. Ester solvents
include the acetates, e.g., ethyl acetate, butyl acetate, hexyl
15 acetate, amyl acetate, etc., propionates such as ethyl
propionate, butyl propionate, etc. Ketone solvents include
acetone, methyl-ethyl ketone, methyl-isopropyl ketone, methyl-
isobutyl ketone, diethyl ketone, cyclohexanone, etc. Glycol
ester solvents include ethylene glycol, monoethyl-ether
20 acetate, etc.

 In testing the coatings prepared in accordance with this
invention, the corrosion protection for an aluminum substrate
was found to be over 2000 hours in 5% salt spray in accordance
with ASTM Test Method B-117 and over 500 hours in SO₂/salt
25 spray in accordance with ASTM Test Method G-85. The coating

1 was found to have outstanding performance when exposed to
extreme heat conditions, high intensity of light and water,
extreme cold conditions, hot lubricating oils and other
chemicals normally found in aircraft operations. By utilizing
5 the coating composition of this invention, a corrosion
resistant film can be obtained on various substrates. The
coating therefore has properties which function as a primer and
more important as a single topcoat which is highly adherent,
flexible, chemical resistant and resistant to all weather
10 conditions. The coatings of this invention lower the risk of
failure due to cracking especially at low temperatures and are
easily touched-up since only one coating need be applied.
Since the coating requires only one coat, it requires less time
for application and removal and thereby saves on manpower that
15 would generally be needed in the preparation of a two coat
system. Moreover, the present coating provides protection at
lower film thicknesses thereby reducing the weight of the
coating compared to a two-coat paint system which is an
important factor when considering aircraft coatings.

20 It is obvious that there are other variations and
modifications which can be made with respect to this invention
without departing from the spirit and scope of the invention .

ABSTRACT OF THE DISCLOSURE

1 A corrosion-resistant coating which can be applied
directly to a surface as a self-priming topcoat comprising a
polyurethane resin binder and a combination of pigments
5 consisting essentially of a molybdate-modified zinc phosphate,
zinc salts of benzoic acids, and an alkaline earth metal
phosphate such as zinc-barium phosphate. In addition, the
coating contains up to about 35 parts by weight of a titanium
dioxide pigment, up to about 3.0 parts by weight of an oil
10 soluble dispersant agent and up to about 50 parts by weight of
at least one organic solvent.